SYLLABUS FOR COMMON CORE SW COURSE

GEOL078, Climate change: what it means to us and what you can do about it

College: Queens College

Department: School of Earth and Environmental Sciences

Course section, Day and Time of Class Meetings: TBD

Building and Room Number: TBD

Instructor name: Dr. Stephen Pekar

Office phone: 718 997 3305

Email: Stephen.pekar@qc.cuny.edu

Email policy: you can contact the professor about class related topics at any time.

Course Description

This course will meet twice a week. There are no prerequisite courses. The first three weeks will cover the basic meteorological principles so students can better understand the climate change crisis, which will be covered for the rest of the semester. There will be weekly online quizzes that will be based on the lectures taught that week as well as reading material that will be assigned for each lecture. There will be three non-cumulative exams given during class time. A final exam given during final exams week will be cumulative. There will also be assignments that the students will have to turn in either on Blackboard or FlipGrid. The latter is a video educational tool in which students create videos for each assignment.

Textbook Information

No textbook is required. All the readings will be from open educational resources, articles, reports, and videos from the web. All the readings can be downloaded from Blackboard. The reading assignments will be found in the tab in the left red panel on Blackboard called Modules. The readings for each week can be found in the weekly module folder. For example, the readings for the first week will be found in the folder labeled, “Week 01”. For Blackboard help: http://qcpages.qc.cuny.edu/edtech/BlackBoard/.

Attendance Policy:

In general, attendance will not be used to evaluate students. The only exception is for taking exams. Students that miss exams will have to document the reason why they were absent to take a make-up exam.

Discipline/Course Specific Learning Objectives:

LO1 be familiar with the basic vocabulary of meteorology, climate and climate change

LO2 explain the mechanics of the earth's atmosphere.

LO3 describe and analyze important environmental problems related to the earth's atmosphere, such as climate change;

LO4 critically examine the atmospheric phenomena of temperature, moisture conditions, atmospheric stability;

LO5 describe the impact that people have on the atmospheric environment;

LO6 expound how the climate crisis will affect people, society, and the world;

LO7 list and state the various lines of evidence that climate change is occurring;

LO8 explain and state basic facts about the changing climate that occurred in the past, present, and will occur in the future;

LO9 be aware what scientists and climate experts have concluded about climate change;

LO10 know what the IPCC is, be able to articulate what it is saying about climate change, and what we have to do about to halt the climate crisis;

LO11 understand how & why sea level is rising due to climate change and what it will mean for coastal in the NYC area and areas around the world;

LO12 recognize how both droughts and fresh water flooding will occur from climate change;

LO13 understand how agriculture is adding greenhouse gases to the atmosphere & what it means for climate change;

LO14 know how civilization and climate change are creating a biodiversity crisis and what it means for humanity;

LO15 recognize some of the politics of climate change; and

LO16 provide examples of solutions to the climate change crisis and what individuals can do about the climate crisis.

CUNY COMMON CORE

(do not modify the below statement – this statement must be included on all QC SW courses)

All Flexible CORE Courses must meet the following <u>three</u> learning outcomes:

FC 1: Gather, interpret, and assess information from a variety of sources and points of view.
FC 2: Evaluate evidence and arguments critically or analytically.
FC 3: Produce well-reasoned written or oral arguments using evidence to support conclusions.

In addition, all SW courses must satisfy at least <u>three</u> of the following learning outcomes:

SW 1: Identify and apply the fundamental concepts and methods of a discipline or interdisciplinary field exploring the scientific world, including, but not limited to: computer science, history of science, life and physical sciences, linguistics, logic, mathematics, psychology, statistics, and technology-related studies.
SW 2: Demonstrate how tools of science, mathematics, technology, or formal analysis can be used to analyze problems and develop solutions.
SW 3: Articulate and evaluate the empirical evidence supporting a scientific or formal theory.
SW 4: Articulate and evaluate the impact of technologies and scientific discoveries on the contemporary world, such as issues of personal privacy, security, or ethical responsibilities.
SW 5: Understand the scientific principles underlying matters of policy or public concern in which science plays a role.

<u>Course Grade:</u>

This course follows the standard Queens College grading policy in which 60% is the minimum passing grade, 90-100% is an A, 80-89% is a B, etc.

The grade for this class is based on the following

Hourly exams	45%
Cumulative Final Exam	30%
Quizzes	10%
Assignments	10%
In class quizzes	5%

Exams: Three hourly written, in-class exams will be scheduled during the semester based on the lectures and reading. A cumulative exam will be given during final exam week that will be based on the three hourly exams. All exams will consist of multiple choice and matching questions. A missed exam can only be taken if there is ample reason for the student's absence (e.g., medical issues that will need documentation).

Quizzes: Weekly online quizzes will be due on Friday and consist of multiple choice and matching questions based on the previous week's lecture and readings. No late quizzes will be

accepted unless there is ample reason for the student's absence (e.g., medical issues that will need documentation).

Assignments: will be written as well as having the students create short videos to orally make observations and explain and interpret data and their observations. No late video or written assignments will be accepted without a valid reason (e.g., medical issues that will need documentation).

Written assignments: will be based on data the students collect such as when they calculate their carbon footprint and their ecological footprint.

Video assignments: will include student-made videos based on questions that they will have to answer after they read articles and watch videos. These videos will be uploaded onto FlipGrid, which can be viewed by the professor and other students in the class.

Syllabus

GEOL 078: Climate change: what it means to us and what you can do about

Week	Class Meeting	Day & Date	Topic	Assignments	Quizzes (normally due on Fridays)	Readings	Links for Readings	Objectives / Criteria Met
1	1	Monday, January 30, 2023	Intro to climate change & class	FlipGrid assignment #1: introduce yourself.	FlipGrid assignment #1: introduce yourself.			
	2	Wednesday, February 1, 2023	Earth's Atmosphere		Blackboard quiz due on Friday	The Composition of our Atmosphere	https://www.e-education.psu.edu/meteo3/l1_p3.html	LO1, LO2, SW1
2	3	Monday, February 6, 2023	Warming and Cooling Earth and Its Atmosphere	FlipGrid assignment: weather & climte between NYC & city in S. hemisphere		Shedding Light on the Electromagnetic Spectrum	https://www.e-education.psu.edu/meteo3/l2_p2.html	LO1, LO2, SW1, SW2
	4	Wednesday, February 8, 2023	Global and Local Controllers of Temperature		Blackboard quiz on lectures 3 & 4	The "Greenhouse Effect," and Global Warming	https://www.e-education.psu.edu/meteo3/l2_p7.html	LO1, LO4, FC1, SW1, SW2
3	5	Monday, February 13, 2023	The Role of Water in Weather			Lesson 4: The Role of Water in Weather	https://www.e-education.psu.edu/meteo3/l4.html	LO1, LO4, FC1, SW1
	6	Wednesday, February 15, 2023	Surface Patterns of Pressure and Wind		Blackboard quiz on lectures 5 & 6	Lesson 6: Surface Patterns of Pressure and Wind	https://www.e-education.psu.edu/meteo3/l6.html	LO1, LO4, SW1, SW2
4	7	Monday, February 20, 2023	Cloud Development and Precipitation & review for exam 1	Flip Grid assignment: Clouds.		Clouds from Bottom to Top	https://www.e-education.psu.edu/meteo3/l5_p3.html	LO1, LO4, SW1, SW2
	8	Wednesday, February 22, 2023	Climate Change: basics causes of climate change		Blackboard quiz on lectures 7 & 8	NASA The Causes of Climate Change	https://climate.nasa.gov/causes/	LO1, LO5, FC1, SW1, SW3
5	9	Monday, February 27, 2023	EXAM 1 (weather topics)					
	10	Wednesday, March 1, 2023	Evidence for climate change			NASA - Climate Change: How Do We Know?	https://climate.nasa.gov/evidence/	LO1, LO5, LO7, LO9, FC1, FC2, SW1, SW3
6	11	Monday, March 6, 2023	Evidence for climate change part II			**NASA Scientific Consensus: Earth's Climate Is Warming**	https://climate.nasa.gov/scientific-consensus/	LO3, LO7, LO9, FC1, FC2, SW3
	12	Wednesday, March 8, 2023	Past climates		Blackboard quiz on lectures 10, 11, & 12	Smithsonian - Everything You Ever Wanted to Know About Earth's Past Climates	https://www.smithsonianmag.com/science-nature/everything-you-ever-wanted-know-about-	LO1, LO8
7	13	Monday, March 13, 2023	IPCC	Calculate your carbon footprint		Headline Statements from the Summary for Policymakers	https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Headline_Statements.pdf	LO1, LO3, LO5, LO7, LO8, LO9, L10, SW3
	14	Wednesday, March 15, 2023	IPCC part II		Blackboard quiz on lectures 13 & 14	IPCC WGI Interactive Atlas	https://interactive-atlas.ipcc.ch/?fbclid=IwAR2lsbKBUPDiQNQs2nzuGpWYM5Mik00Qo2Tpb	LO6, LO7, LO8, LO9, LO10, FC2, SW3
8	15	Monday, March 20, 2023	Sea level changes & Coastal flooding	Calculating future sea level change in your area		Oceanography -Ancient Sea Level as Key to the Future	https://tos.org/oceanography/assets/docs/33-2_miller.pdf	LO3, LO5, LO11, FC2, FC3, SW5
	16	Wednesday, March 22, 2023	Droughts, wild fires & water shortages from Climate Change		Blackboard quiz on lectures 15 & 16	IPCC report 2021 Chapter 8: Water cycle changes	https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_08.pdf	LO3, LO5, LO12, SW5
9	17	Monday, March 27, 2023	Droughts, wild fires & water shortages from Climate Change part II	Calculate your water footprint		NRDC - Drought: Everything You Need to Know	https://www.nrdc.org/stories/drought-everything-you-need-know?gclid=CjwKCAjwx8iI	LO3, LO5, LO6, LO12 FC3, SW5
	18	Wednesday, March 29, 2023	Fresh water flooding from climate change & Review for exam 2		Blackboard quiz on lectures 17 & 18	NYAS - New York City Panel on Climate Change 2015 Report Executive Summary	https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.12591	LO3, LO5, LO6, SW5, LO12
spring break								
10	19	Monday, April 10, 2023	EXAM 2 (Climate change part 1)					
	20	Wednesday, April 12, 2023	Agriculture and climate change			WSJ - We Can't Waste a Drop.' India Is Running Out of Water	https://www.wsj.com/articles/we-cant-waste-a-drop-india-is-running-out-of-water-	LO3, LO5 , LO6,LO13, SW5
11	21	Monday, April 17, 2023	Biodiversity Crisis	calculate your ecological footprint		Nature paper: Biodiversity loss and its impact on humanity	https://www.nature.com/articles/nature11148	LO3, LO5, LO6,LO14, SW5

Syllabus

GEOL 078: Climate change: what it means to us and what you can do about

Week	Class Meeting	Day & Date	Topic	Assignments	Quizzes (normally due on Fridays)	Readings	Links for Readings	Objectives / Criteria Met
11	22	Wednesday, April 19, 2023	Biodiversity Crisis part II		Blackboard quiz on lectures 20, 21 & 22	Food system impacts on biodiversity loss	https://www.ciwf.com/media/7443948/food-system-impacts-on-biodiversity-loss-feb-	LO3, LO5, LO6, LO14, SW5
12	23	Monday, April 24, 2023	Politics of climate change			Guardian - Oil firms knew decades ago fossil fuels posed grave health risks, files reveal	https://www.theguardian.com/environment/2021/mar/18/oil-industry-fossil-fuels-air-pollution-	LO3, LO15, FC2
	24	Wednesday, April 26, 2023	Politics of climate change Part II		Blackboard quiz on lectures 23 & 24	Corporate TV News spent over two hours covering landmark climate report	https://www.mediamatters.org/broadcast-networks/corporate-tv-news-spent-over-two-	LO15, FC1, FC2
13	25	Monday, May 1, 2023	Climate solutions			Bending the Curve: Climate Change Solutions Digital Textbook CH 5		LO16, FC1
	26	Wednesday, May 3, 2023	Climate solutions Part II & Review for exam 3		Blackboard quiz on lectures 25 & 26	'Insanely cheap energy': how solar power continues to shock the world	https://www.theguardian.com/Australia-news/2021/apr/25/insanely-cheap-energy-how-	LO16, FC1
14	27	Monday, May 8, 2023	Climate solutions Part III & review for final exam			Bending the Curve: Climate Change Solutions Digital Textbook CH 7		LO16, FC1
	28	Wednesday, May 10, 2023	EXAM 3 (Climate change part 2)					
15	29	Monday, May 15, 2023	FINAL CUMULATIVE EXAM					

APPENDICES: ASSIGNMENT EXAMPLES

GEOL078 Assignment: Calculating your ecological footprint

Note: this assignment will address learning outcomes:

FC 1: gather, interpret, and assess information from a variety of sources and points of view;

FC 2: evaluate evidence and arguments critically or analytically

FC 3: Produce well-reasoned written or oral arguments using evidence to support conclusions

SW 3: Articulate and evaluate the empirical evidence supporting a scientific or formal theory.

SW5: Understand the scientific principles underlying matters of policy or public concern in which science plays a role

Materials: Computer with Internet access and Microsoft Word

Procedure:

1. We will go over the concept of footprints and how your ecological, carbon, and water footprints contribute to environmental issues.

2. Before you begin, carefully read the background material before you begin this assignment.

3. Go to the website below and calculate your ecological footprint by completing the online ecological footprint calculator (http://www.footprintcalculator.org/).
Once you calculate your footprint, insert a screenshot of the detailed results.

4. Compare your results to the average American ecological footprint (According to the Global Footprint Network an average American has an Ecological Footprint of about 10.3 hectares).

5. Write up at least one page summary. Include in your summary:

- What is meant by ecological overshoot?
- How does your results compare to the average American ecological footprint?
- Address specific items such as food, carbon footprint, housing, and other factors (what category comprises the highest percentage of your footprint? the lowest?).
- Do you think there are areas that you can work on to reduce your impact?

GEOL078 Assignment: Calculating your carbon footprint

Note: this assignment will address learning outcomes:
FC 1: gather, interpret, and assess information from a variety of sources and points of view;
FC 2: evaluate evidence and arguments critically or analytically
FC 3: Produce well-reasoned written or oral arguments using evidence to support conclusions
SW 3: Articulate and evaluate the empirical evidence supporting a scientific or formal theory.
SW5: Understand the scientific principles underlying matters of policy or public concern in which science plays a role
Materials: Computer with Internet access and Microsoft Word

Procedure:
1. We will go over the concept of footprints and how your ecological, carbon, and water footprints contribute to environmental issues.

2. Before you begin, carefully read the background material before you begin this assignment.

3. Determine your Carbon Footprint by completing an online carbon footprint calculator. (https://www.nature.org/en-us/get-involved/how-to-help/consider-your-impact/carbon-calculator/

When filling out the carbon footprint, put down one person as your household in order to calculate your personal carbon footprint. If you do not know how much electricity, natural gas, heating oil, or water

your home uses, you may use the following average quantities:
§ Electricity: 2,600 kWh/year
§ Natural Gas: 24,000 ft^3/year
§ Heating Oil: 70 gallons/month
§ Water Usage: leave at 1x
When you complete the quiz, click on the small bar graph icon to see the how your footprint compares to similar households.

Insert a screenshot of the results of your quiz as an answer.

4. Nature.org website [http://www.nature.org/greenliving/carboncalculator/] says that the average American emits 27 tons of CO_2 equivalents per year while the world average per person is 5.5 tons of CO_2 equivalents per year.

5. Write up at least one page summary. Include in your summary:

- How does your Carbon Footprint compare with that of an average American (support your answers with the numbers in the data. How much higher or lower is your footprint)?
- Address specific items such as travel, home, food, goods, and services (what category comprises the highest percentage of your footprint? the lowest?).
- State two (2) ways you can reduce your Carbon footprint.

GEOL078

Assignment: Calculating your water footprint

Note: this assignment will address learning outcomes:
FC 1: gather, interpret, and assess information from a variety of sources and points of view;
Materials: Computer with Internet access and Microsoft Word

Procedure:

1. We will go over the concept of footprints and how your water footprint contribute to environmental issues.

2. Before you begin, carefully read the background material before you begin this assignment.

3. Go to the website below and calculate your Water Footprint by completing the online Water Footprint calculator quiz. https://www.watercalculator.org/

Insert a screenshot of the results of your quiz (make sure to include the bar graph showing where your water usage comes from).

4. People in the United States have an average Water Footprint of 2,842 cubic meters per year and China 1,071 cubic meters per year.

• Convert your results from gallons/day to cubic meters per year using the following information:

- 1 cubic meter = 264.17 gallons
- 365 days = 1 year
- example: 1,593 gallons/day * 365 days/year * 1 m3/264.17 gallons = 2201 m3/year

5. Write up at least one page summary. Include in your summary:

• How does your Water Footprint compare with that of an average American (support

your answers with the numbers in the data. How much higher or lower is your

footprint)?

- Address specific items such as indoor water, outdoor water, virtual water, as well as

- the subcategories like shower, swimming pool, shopping, diet, etc (what category
- comprises the highest percentage of your footprint? the lowest?).
- State two (2) ways you can reduce your Water footprint.
- Compare your water usage to that of the average New Yorker.

Questions to be answered in your summary.

The New York City Department of Environmental Protection (NYCDEP) estimates that the average New Yorker uses an average of 65 gallons of water per day. If you use the same amount of water as an average New Yorker, how much water would you have consumed in a year?
It is estimated that 50-75% of our household water consumption occurs in the bathroom. A standard toilet uses an average of 5.75 gallons per flush, a lower consumption toilet uses an average of 1.6 gallons per flush.

If you switch from using a regular toilet to a lower consumption one, how many gallons of water. would you save per year? Assume you use the bathroom about four times per day.

GEOL078 Assignment: Sea-Level Rise

Note: this assignment will address learning outcomes:
FC 1: gather, interpret, and assess information from a variety of sources and points of view;
SW 1: Identify and apply the fundamental concepts and methods of a discipline or interdisciplinary field exploring the scientific world, including, but not limited to: computer science, history of science, life and physical sciences, linguistics, logic, mathematics, psychology, statistics, and technology-related studies.
SW 2: Demonstrate how tools of science, mathematics, technology, or formal analysis can be used to analyze problems and develop solutions.
SW 3: Articulate and evaluate the empirical evidence supporting a scientific or formal theory.
SW 5: Understand the scientific principles underlying matters of policy or public concern in which science plays a role.

Learning Objectives

- Students will discover how global sea level rise is affecting locations in and around the NYC area.

Materials

- Lecture notes
- Projector & Computer
- Computers with Internet access & video streaming capability
- NOAA Digital Coast Sea Level Rise Viewer

Preparation

- Preview NOAA Digital Coast Sea Level Rise Viewer.
- Read the articles on Blackboard in the sea level activity folder.

Procedure

Explain how climate warming causes sea level rise.

- Watch the video (TBD)
- Know what the two reasons for sea level rise: (1) seawater expands with heat, and (2) water is added to the ocean as land-ice melts.

Investigate maps that show the impacts of sea level rise.

- Over this century, sea level will rise an average of 1.7-7.0 feet (0.5-2.3 m) worldwide. There are also a variety of unknowns, such as whether large parts of ice sheets will slip into the ocean and how ocean currents will change due to warmer temperatures.
- In this activity, you will explore what the impact of higher seas and lower land will be in and around the NYC area.

- Pick three locations that are along the coast. Suggestions include Staten Island, southern Queens or Brooklyn, Manhattan, and along the south shore of Long Island such as Long Beach and areas bordering on the bay side.
- Move the sea level bar, first at one foot, 3 feet, 5 feet, & then 7 feet and see observed when or if the sea level rise reaches a location.

Discussion: Sensemaking

- Identify and discuss which are the most vulnerable places from sea level rise and those that are safer from flooding. Provide some examples and how much the water is expected to rise in those areas.

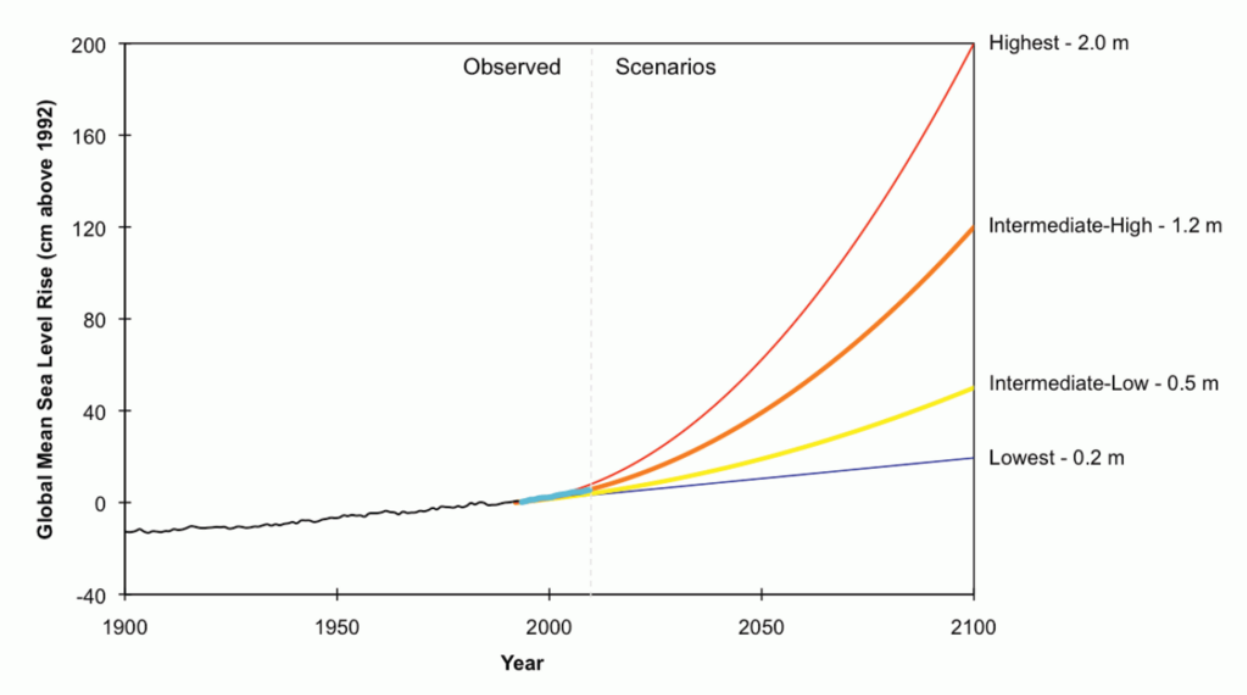
Background

Sea Level Rise

Since 1900, sea level has risen on average 1.4 millimeters per year, which is ten times faster than sea level rise over the previous 3,000 years. The rate of global sea level rise is accelerating: it has more than doubled from 0.06 inches (1.4 millimeters) per year throughout most of the twentieth century to 0.14 inches (3.6 millimeters) per year from 2006–2015. Looking into the future, models project the rate of sea level rise will increase with a doubling every couple of decades (Hanson et al., 2015).

Scientists use averages from a large number of tide gauges worldwide to estimate the global average sea level. Since 1992, global sea level has also been observed using satellite data too, with more accurate results than tide gauges (according to the Intergovernmental Panel on Climate Change AR4 report). Satellite measurements show a rate of sea level rise of 3 mm per year, far more than the tide gauges. Some scientists suspect that the satellite is incorrectly calibrated. Others suspect that the difference may be because the satellite measurements cover much of the globe while tide gauges are near coastlines.

The graph below shows the global mean sea level rise estimates due to melting ice and thermal expansion for four scenarios (according to Parris et al., 2012). Notice that there is a wide range in the scenarios, in part because there are unknowns about how much we will decrease greenhouse gas emissions in the future, and in part because of the possibility of the Antarctic and Greenland ice sliding into the ocean. Notice also that the rate of sea level rise is likely to be non-linear, with an increasing rate of sea level rise over time.



How climate change causes sea level rise

There are two ways that a hotter climate leads to sea level rise: (1) as temperatures warm, ice that is on land melts and the water is added to the ocean, and (2) as the water in the ocean warms, it expands. Both are described below in more detail.

Melting Ice

There are between 24 and 30 million cubic km of ice on land. About 90% of this ice is in Antarctica. Most of the remaining ice is in Greenland, and a tiny fraction is locked up in mountain glaciers elsewhere. As global temperatures rise, some of this ice is melting, and the meltwater flows into the ocean, gradually raising sea level. Melting has outpaced snowfall, and the most substantial loss of ice has been on mountain glaciers in the mid-latitudes and tropics and on the Greenland ice sheet.

Additionally, warmer temperatures can cause ice in glaciers and ice sheets to flow faster towards the oceans. In Antarctica, ice is now flowing towards the ocean at a faster rate than in the past. Complete melting of glaciers and ice sheets would raise sea levels worldwide, almost 70 meters (230 feet) above current levels. Of this rise, 7.2 meters would be from the Greenland ice sheet, and 61.1 meters would be from the Antarctic ice sheet. Melting glaciers would add another half of a meter.

For some perspective on all this melting ice, consider this: sea level has risen about 120 meters since the last glacial maximum (approximately 20,000 years ago) when ice covered large parts of the Northern Hemisphere and wooly mammoths roamed the Earth.

Note that melting sea ice, which is ice formed from sea water, has only a very minor impact on sea level since the ice is already in the water.

Thermal Expansion of Seawater

Water expands as it gets warmer, and it is warmed as the climate warms. The amount the water warms is very small, but since there is so much water in the ocean, it expands a lot. Scientists estimate that nearly half of sea level rise is due to thermal expansion of sea water.

For example, suppose 1 liter of water, initially at 20° C, was heated to 21° C. It would expand by 0.021% (see the table of volume and temperature). It would increase in volume by 0.21 milliliters. This tiny increase seems trivial, but the ocean contains about 1,400,000,000 cubic kilometers of water. Even a tiny fractional increase adds up to a very large increase in volume, and hence substantial sea level rise.

The different layers of the ocean (surface layers and deep ocean) are not heated equally. Also, the volumes of the various layers are not the same, nor are their initial temperatures, which affects the rate at which they expand.

- The surface layer of the ocean contains roughly 50,000,000 km^3 of water and has temperatures ranging from freezing near the poles to around 30° C in the tropics.
- The mid-ocean, where the thermocline produces the transition from a warm surface to cold deep water, holds about 460,000,000 km^3 of water and spans a wide range of temperatures.
- The deep ocean holds the most water, some 890,000,000 km^3, but because of its relatively cool temperatures of 4° C or less, it is also less prone to expansion as its temperature rises slightly.

References

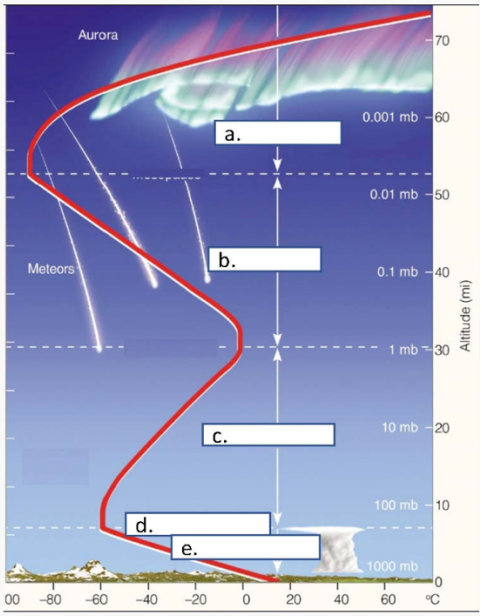
https://scied.ucar.edu/activity/sea-level-rise

Some sample questions that could be used on the weekly quizzes or the hourly 3 hourly exams for GEOL078.

Matching: 4: Match the following atmospheric layer...

Question

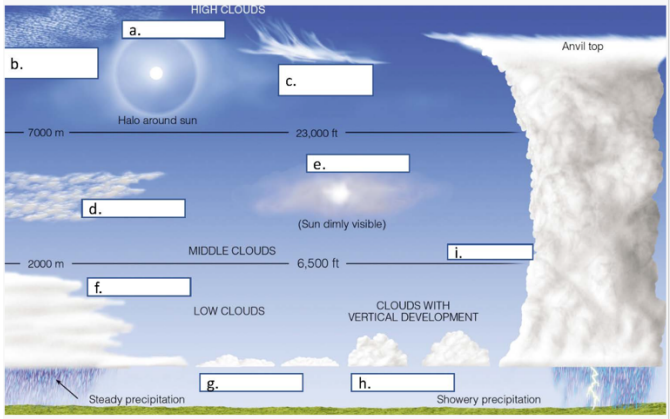
Match the following atmospheric layers based on the figure.



Answer

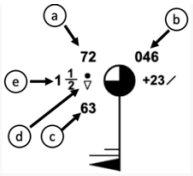
Match	Question Items	Answer Items
A. -	A. a.	A. thermosphere
B. -	B. b.	B. Mesosphere
C. -	C. c.	C. stratosphere
D. -	D. d.	D. tropopause
E. -	E. e.	E. Trophosphere

Look at the figure and match the clouds



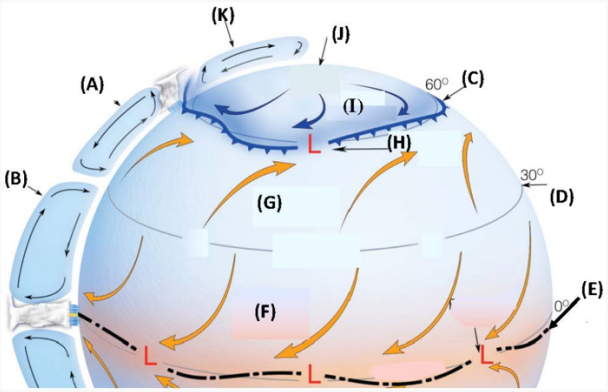
Match	Question Items	Answer Items
A. -	A. a.	A. cirrostratus
B. -	B. b.	B. cirrocumulus
C. -	C. c.	C. cirrus
D. -	D. d.	D. altocumulus
E. -	E. e.	E. altostratus
F. -	F. f.	F. nimbostratus
G. -	G. g.	G. stratocumulus
H. -	H. h.	H. cumulus
I. -	I. i.	I. cumulonimbus

Match the following weather observations to what is shown on the weather station below.

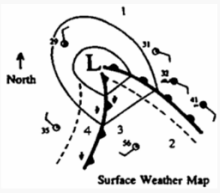


Match	Question Items	Answer Items
A. -	A. temperature	A. a
B. -	B. barometric pressure	B. b
C. -	C. dew point	C. c
D. -	D. visibility	D. d

Look on the figure below and find the letters (e.g., (A), (B), etc.). . Match each letter to the correct wind and surface-pressure features.



Match	Question Items	Answer Items
A. -	A. (A)	A. Ferrel Cell
B. -	B. (B)	B. Hadley Cell
C. -	C. (C)	C. Polar Front
D. -	D. (D)	D. Doldrums/ subtropical High
E. -	E. (E)	E. Intertropical Convergence Zone
F. -	F. (F)	F. Northeast trade winds
G. -	G. (G)	G. Westerlies winds
H. -	H. (H)	H. Subpolar Low
I. -	I. (I)	I. Polar easterlies
J. -	J. (J)	J. Polar High



The following questions refer to the above illustration of a mid-latitude cyclone (the dashed lines show the positions of the fronts 6 hours ago).

Consider the accompanying figure. At which of the four positions would you expect to hear the following 12-hour forecast?
"Cloudy and cold this morning with snow this afternoon and tonight?"

- a. 1
- b. 2
- c. 3
- d. 4

Match	Question Items	Answer Items
A. -	A. Carbon dioxide	A. is the most important greenhouse gas that affects our climate.
B. -	B. Nitrous oxide	B. comes mainly from fertilizer, industrial processes and has a global warming potential of around 300.
C. -	C. Methane	C. has a global warming potential of 25 times
D. -	D. CFC's and HCFC's	D. come mainly from liquid coolants and have a global warming potential in the thousands.

Match	Question Items	Answer Items
A. -	A. A positive feedback when CO2 and methane increase would be	A. atmospheric temperatures increase followed by more evaporation, which increases water vapor and thereby produces more warming
B. -	B. Climate feedback loops	B. are processes that can either amplify or diminish the effect of climate forcing
C. -	C. Natural sources of methane include:	C. permafrost frozen ocean sediment
D. -	D. A tipping point	D. when the climate system enters a new state and cannot be reversed

Match the following about astronomical cycles

Match	Question Items	Answer Items
A. -	A. Milankovitch cycles	A. the theory that as the Earth travels around the sun changes in the shape of Earth's orbit and changes in the tilt of its axis affects climate at the ten thousand to hundred thousand year time scales
B. -	B. Eccentricity cycle	B. slight changes in the shape of Earth's orbit from a nearly perfect circle to a bit more elliptical at approximately 100,000-year cyclicity.
C. -	C. Precessional cycle	C. the wobble of Earth;'s axis at approximately 23,000-year cyclclity
D. -	D. Obliquity cycle	D. The change in the angle of the tilt of Earth's axis that occurs at approximately every 41,000 years

Carbon dioxide levels during the pre-industrial era were _____ .
Today carbon dioxide levels are at _____.

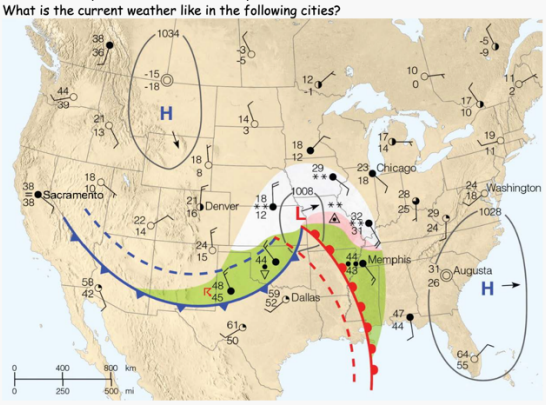
380 ppm
414 ppm

180 ppm
410 ppm

280 ppm
320 ppm

✔ 280 ppm
414 ppm

Look at the map below and match the city to the weather.
What is the current weather like in the following cities?



Match	Question Items	Answer Items
A. -	A. Memphis	A. Cool with light winds from the southeast
B. -	B. Dallas	B. mild temperatures with light winds from the southwest
C. -	C. Augusta	C. cold temperatures with calm winds
D. -	D. Sarcamento	D. cold and fog with light winds from the southeast

E. warm temperatures and moderately strong winds from the north.

F. cold temperatures and winds from the northeast.

f

Between 1970 and today, global temperatures _____.,which is due _____

- [x] increased/ to a rapid increase of greenhouse gases
- [ ] slowly increased/ to solar intensity increased
- [ ] rapidly increased/ to aerosol increased
- [ ] decreased/ rapid increase of greenhouse gases

Which part of the Earth has the greatest warming taken place in the last hundred years?

- [x] In the Arctic
- [ ] Along the equator
- [ ] Over South America and Australia
- [ ] Over the oceans

Match	Question Items	Answer Items
A. -	A. A positive feedback when CO2 and methane increase would be	A. atmospheric temperatures increase followed by more evaporation, which increases water vapor and thereby produces more warming
B. -	B. Climate feedback loops	B. are processes that can either amplify or diminish the effect of climate forcing
C. -	C. Natural sources of methane include:	C. permafrost frozen ocean sediment
D. -	D. A tipping point	D. when the climate system enters a new state and cannot be reversed

How much does the ocean absorb the warming that is taking place today?

- [x] The ocean absorbs ~90% of the warming
- [ ] The ocean absorbs about the same as the atmosphere
- [ ] The ocean absorbs less than the atmosphere that is why the atmosphere is warming so fast
- [ ] The ocean absorbs about half of the total warming

What does humanity need to do to keep global temperature rise below 1.5°C

- [x] CO2 emission must decline by about 45% by 2030.
- [ ] Humanity needs to start using horses and carriages again.
- [ ] We have many decades to slow emissions. That is why politicians are not moving fast on reducing fossil fuel emissions.
- [ ] We don't have to worry as we are already doing a great job in reducing emissions.

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Match the following sea level projection to the correct person or organization

Match	Question Items	Answer Items
A. -	A. ~3 feet	A. IPCC Report 2021
B. -	B. ~6 feet	B. DeConto and Pollard, 2003
C. -	C. 7-11 feet	C. Hansen et al., 2015
D. -	D. 11-31 inches of sea-level rise in the NYC area	D. NPCC 2015 report

Which of the following is considered to be the most catastrophic to humanity and the world?

Sea-level rise

tornados

hurricanes

✓ the collapse of the biodiversity ecosystems

Match the following generating electricity from solar 24 hours a day.

Match	Question Items	Answer Items
A. -	A. Solar power using molten salt	A. uses solar reflectors instead of solar panels
B. -	B. the solar energy is reflected toward a tower	B. that contains the salt that melts from all the heat.
C. -	C. the molten salt is used to	C. turn water into steam that then turns turbines to produce electricity.
D. -	D. The energy produced by solar thermal	D. can compete with natural gas during nighttime peak demand.

Match the following

Match	Question Items	Answer Items
A. -	A. The ecological footprint is	A. the impact of humans on the environment.
B. -	B. the carbon footprint	B. the amount of carbon generated from our daily activities
C. -	C. The total area of biologically productive land and water required to provide the resources and assimilate all the waste produced by a person the	C. is the full definition of ecological footprint.
D. -	D. the ecological overshoot	D. occurs when a population exceeds the long-term carrying capacity of its environment.

How much does the ocean absorb the warming that is taking place today?

✓ The ocean absorbs ~90% of the warming

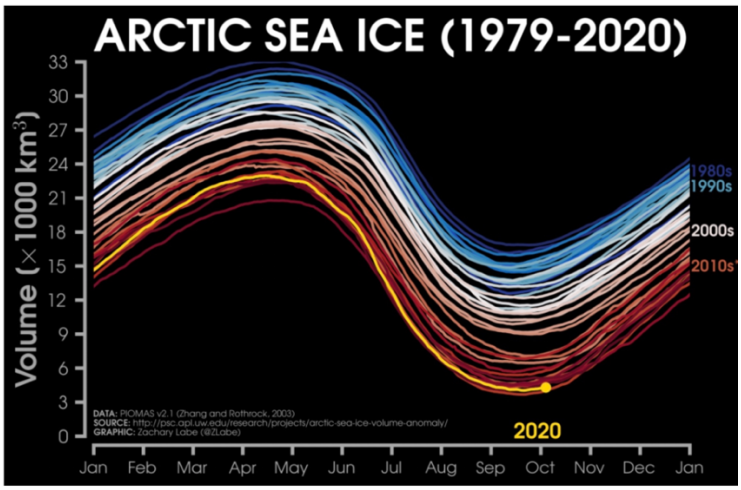
The ocean absorbs about the same as the atmosphere

The ocean absorbs less than the atmosphere that is why the atmosphere is warming so fast

The ocean absorbs about half of the total warming

Question Title	5
Question	Between 1970 and today, global temperatures _____,which is due _____
Answer	✔ a. increased/ to rapid increase of greenhouse gases
	b. slowly increased/ to solar intensity increased
	c. rapidly increased/ to aerosol increased
	d. decreased/ rapid increase of greenhouse gases

Question Title	11
Question	What can you say about the trends of Arctic sea ice?



Answer	a. The last decade (2010's) has had some of the lowest sea-ice volume.
	b. The 1990's has had some of the lowest sea-ice volume only.
	c. It cannot be determined whether sea-ice volume is decreasing only.
	d. The sea-ice volume in 2020 is one of the lowest on record only.
	e. Both a and c

Question Title	8
Question	How much does the ocean absorb the warming that is taking place today?
Answer	✓ a. The ocean absorbs ~90% of the warming b. The ocean absorbs about the same as the atmosphere c. The ocean absorbs less than the atmosphere that is why the atmosphere is warming so fast d. The ocean absorbs about half of the total warming

Details: Multiple Choice Question

Question Title	23
Question	How long do we have before CO2 levels rise so that global temperatures of 1.5°C above pre-industrial levels are inevitable?
Answer	✓ a. About 7 years b. 25 years at least c. It is too late we passed it already d. About 35 years

Details: Multiple Choice Question

Question Title	17
Question	Who was the first person to show that certain gases trap infrared radiation?
Answer	✓ a. John Tyndall b. Svante Arthenius c. Marie Currie d. Lord Kelvin

Details: Multiple Choice Question

Question Title	27
Question	What is coral bleaching?
Answer	✓ a. The surface waters get too hot, the symbiotic algae is expelled by the corals
	b. This is when pollution gets into the ocean and the pollution chemicals turn the coral white.
	c. When CO2 levels get too high and it oxidizes the coral.
	d. This is when you buy corals and before it is sold, they have to purify the coral.

Details: Multiple Choice Question

Question Title	1
Question	What is the top climate change concern in the world?
Answer	✓ a. droughts and water shortages
	b. Severe weather like floods or intense storms
	c. heavy precipitation events
	d. Rising sea levels

Question Title	9
Question	The U.N. report on the collapse of biodiversity ecosystems states
Answer	a. Nature is declining globally at rates unprecedented in human history – & the rate of species extinctions is accelerating, with grave impacts on people around the world now likely. b. average abundance of native species in most major land-based habitats has fallen by > 20%. c. >40% of amphibian species, ~33% of reef-forming corals and > 33% of all marine mammals are threatened. ✔ d. All of the above e. None of the above

Question Title	4
Question	4) Why is the water situation so dire in India?
Answer	a. ~ 600 million Indians face "high to extreme water stress" and about 200,000 die each year because they can't get a clean supply. b. By 2030, water availability will be half what India needs. c. An estimated 21 major cities (~10% of the population) could exhaust their groundwater supplies **within two years**, government advisors believe. ✔ d. All of the above e. None of the above

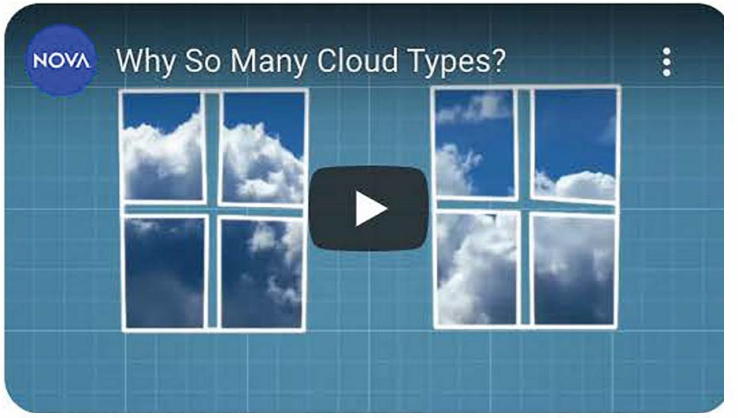
Details: Multiple Choice Question

Question Title	25
Question	Even if CO2 emissions are greatly reduced, what are the following are true?
Answer	a. High CO2 levels will persist for centuries
	b. Sea-level rise will continue for centuries
	c. Global temperatures will level off and begin to slowly fall.
	d. Global temperatures level will quickly begin to reduce
	✓ e. Only a and b
	f. Only a, b, and c
	g. Only c and d

Sep 23, 2021 **This is one of the flipgrid assignments the students will do by creating a video.**

09 23 finding your most interesting cloud!

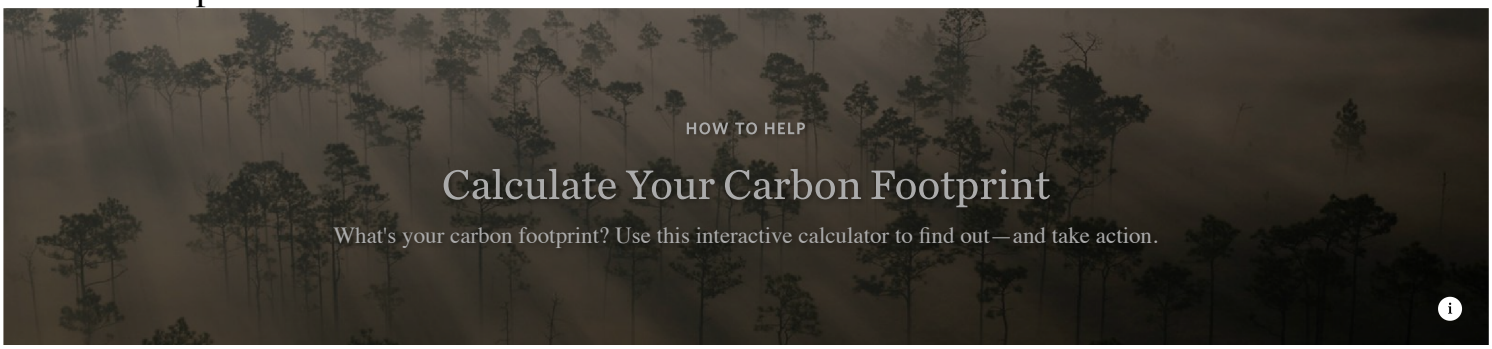
20 responses • 313 views • 0 comments • 5.7 hours of discussion



This FlipGrid activity will allow you to explore the sky and use your newly acquired knowledge of clouds to identify cloud types and then compare what the weather is currently like and what it is forecasted to be.
Make a FlipGrid video of a cloud (& you) over the next 7 days. Try to find the most interesting, unusual, and or beautiful clouds to video (Extra credit for videos that have clouds that are special). Attached is the weather forecast for the next few days & it looks like you will have plenty of opportunities to see different types of clouds.

Your video should have the following: Include you and the cloud you want to discuss. Identify & name the cloud. Describe the cloud, such as elevation (high/middle/ low), how it forms, & what type of weather it forms in, and if precipitation can fall from it. Finally, state why you picked this cloud and if there is anything special about this cloud or cloud type that has intrigued you in the past. Look at the video.

This the website that the students will use to calculate their carbon footprint.



What is a carbon footprint?

A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions.

The average carbon footprint for a person in the United States is 16 tons, one of the highest rates in the world. Globally, the average carbon footprint is closer to 4 tons. To have the best chance of avoiding a 2°C rise in global temperatures, the average global carbon footprint per year needs to drop to under 2 tons by 2050.

Lowering individual carbon footprints from 16 tons to 2 tons doesn't happen overnight! By making small changes to our actions, like eating less meat, taking fewer connecting flights and line drying our clothes, we can start making a big difference.

Carbon Footprint Calculator

The Nature Conservancy

DONATE

Get Started

START WITH A QUICK CARBON FOOTPRINT ESTIMATE

Zipcode | State | City | County | Country

Forest Hills, New York 11375

How many people live in your household?

Avg (2.5) 1 2 3 4 5+

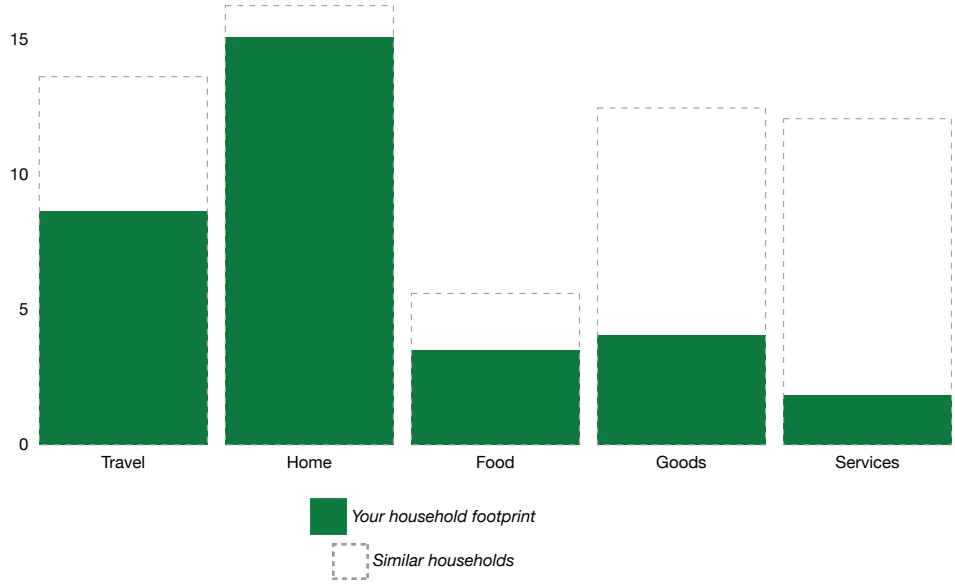
What is your approximate gross annual household income?

Avg <10k 10k 20k 30k 40k 50k 60k 80k 100k 120k+

NEXT

33 tons CO_2/year	60 tons CO_2/year	45%
Your Total Footprint	Similar Households	Better than Average

Household tons CO_2/year



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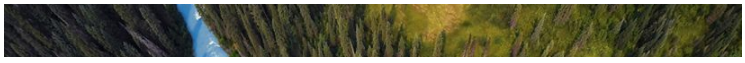


CLIMATE CENTRAL

COASTAL RISK SCREENING TOOL

LAND BELOW 6.1 FEET OF WATER

A water level of 6.1 feet above the high tide line could be reached through combinations of sea level rise, tides, and storm surge.

DETAILS AND LIMITATIONS

WATER LEVEL

6.1 ft

Feet - Meters

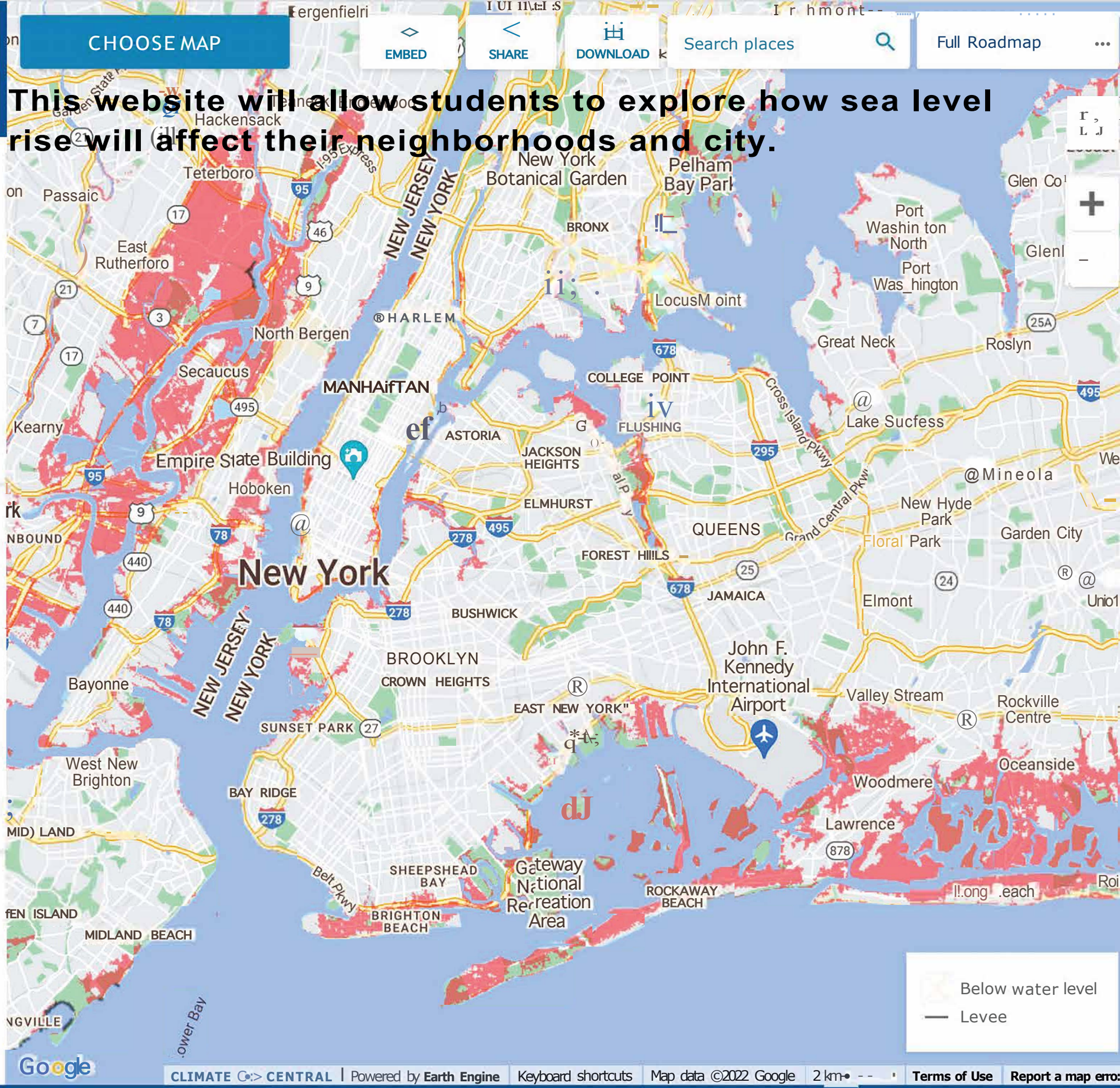
CHANGE OTHER SETTINGS

Video Tutorial 0

CHOOSE MAP

EMBED SHARE DOWNLOAD Search places Full Roadmap

This website will allow students to explore how sea level rise will affect their neighborhoods and city.



This is an example of what the students will do to calculate their water footprint.

Your water footprint:

Personal: 1,037 Gallons/Day

Household: 2,075 Gallons/Day

Indoor Water Outdoor Water Virtual Water

Your water footprint:

Personal: 1,037 Gallons/Day

Household: 2,075 Gallons/Day

Gallons/Day:	You	US Average
Indoor Water		
household		
2 household members		
shower	**20**	**11**
under 5 min with conventional showerheads		TIPS (/POSTS/SHOWER-BATH/)
bathtub	**0**	**2**
0 per day		TIPS (/POSTS/SHOWER-BATH/)
bathroom sink	**6**	**3**
under 5 min with low-flow faucets		TIPS (/POSTS/BATHROOM-SINK/)
toilet	**8**	**14**
don't "let it mellow" with low-flow toilets		TIPS (/POSTS/TOILET/)
kitchen sink	**6**	**7**
under 5 min with with low-flow faucets		TIPS (/POSTS/COOKING/)

dishes	**27**	**1**	TIPS (/POSTS/DISH-WASHING/)
with my own two hands 2 load(s) per day			
laundry	**1**	**10**	TIPS (/POSTS/LAUNDRY/)
laundromat or pay someone else 2 time(s) per month			
greywater system	**0**	**-25**	TIPS (/POSTS/GREYWATER/)
don't have a greywater system			
Outdoor Water			
lawn & garden	**0**	**72**	TIPS (/POSTS/LAWNS-GARDENS/)
don't water			
rain barrel	**0**	**-2**	TIPS (/POSTS/RAIN-BARRELS/)
don't have a rain barrel			
swimming pool	**0**	**23**	TIPS (/POSTS/SWIMMING-POOL/)
don't have a swimming pool			
carwashing	**0**	**1**	TIPS (/POSTS/CAR-WASHING/)
do not wash			
Virtual Water			
driving	**0**	**5**	TIPS (/POSTS/GASOLINE/)
30 miles per week			
electricity	**100**	**30**	TIPS (/POSTS/ELECTRICITY/)
New York, 100% utility power, 0% renewable power			
shopping habits	**291**	**583**	TIPS (/POSTS/SMARTER-SHOPPING/)
shop for basics			
paper	**-4**	**-3**	TIPS (/POSTS/RECYCLE-PAPER/)
all paper recycled			
plastic	**-16**	**-1**	TIPS (/POSTS/RECYCLE-PLASTIC/)
all plastic recycled			

Your water footprint:

Personal: 1,037 Gallons/Day

Household: 2,075 Gallons/Day

bottles & cans	**-30**	**-8**
all bottles & cans recycled		TIPS (/POSTS/RECYCLE-BOTTLES-AND-CANS/)
fabrics	**-6**	**-1**
always recycle fabrics		TIPS (/POSTS/REUSE-RECYCLE-CLOTHES-AND-LINENS/)
diet	**485**	**1063**
1 vegan, 1 vegetarian		TIPS (/POSTS/FOOD-CHOICES/)
pet food	**150**	**48**
$45 per month on pet food		TIPS (/POSTS/PET-FOOD-PURCHASES/)

Get your result and 3 month reminder.

Your Email Address SUBMIT

Methodology (/footprints/water-footprint-calculator-methodology/)

(https://www.pinterest.com/WaterCalculator)